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ANL-4551

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Subject Category: PHYSICS

UNITED STATES ATOMIC ENERGY COMMISSION

EXPERIMENTAL FACILITIES PROVIDED IN THE
MATERIALS TESTING REACTOR

Preliminary Report

By
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December 29, 1949

Argonne National Laboratory
Lemont, Illinois

Technical Information Service, Oak Ridge, Tennessee

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Printed in USA, Price 30 cents. Available from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

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EXPERIMENTAL FACILITIES PROVIDED IN THE
MATERIALS TESTING REACTOR

PRELIMINARY REPORT

by

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Materials Testing Reactor Project

Issued as ANL-SM-122
December 29, 1949

Reissued as ANL-4551
December 26, 1950

Operated by the University of Chicago
under
Contract W-31-109-eng-38

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I. INTRODUCTION.

The purpose of this report is to present to the scientists working in the Atomic Energy field a survey of the facilities that will be provided in the Materials Testing Reactor. A brief description of the general site of the reactor's facilities, and a brief description of the laboratories and shops to be provided with the reactor are included along with a detailed description of the experimental facilities.

The drawings included in this report are preliminary. The final construction drawings are not completed. These drawings and the dimensions appearing on them should not be used for design of experimental equipment. A more complete report with construction drawings will be issued when the reactor design has been completed.

The experimental facilities required for a Materials Testing Reactor were discussed at a conference held at Argonne National Laboratory on October 5, 1948. The men present at that conference recommended that the basic design of the High Flux Pile be accepted since the experimental facilities designed in this pile were essentially those needed in a Materials Testing Reactor. It was recommended that, if possible, through holes near the highest flux be designed into the reactor. With two such experimental holes designed into the reactor, the High Flux Pile became the Materials Testing Reactor. During the past year many minor but no major changes have been made as the detailed design proceeded toward completion. Oak Ridge National Laboratory has been responsible for the design of the High Flux Pile and continues to be responsible for the design of the reactor including the experimental facilities. Argonne National Laboratory is responsible for the design of the hole plugs and the buildings and utilities for the project.

During the design the basic principle to include the maximum number of experimental facilities physically possible in a reactor of this size has been followed. The design permits very broad flexibility in the use of the various experimental facilities; but, due to the proximity of one facility to another, there will be limits to the number of facilities that can be used at any one time. A summary of the experimental facilities is presented on page 4.

II. GENERAL DESCRIPTION OF THE REACTOR AND FACILITIES.

A. Reactor and Experimental Facilities

The Materials Testing Reactor design consists of highly enriched fuel elements, in the form of aluminum clad plates brazed into an assembly of approximately three inch square cross section, a number of which can be loaded into a rectangular or square core according to the type of experiments being undertaken. The core is surrounded by a beryllium reflector and the entire assembly is installed near the bottom of a tall tank, the bottom or aluminum section of which is shown in Figure 1. The active section can be fully loaded with fuel assemblies if operating conditions should demand and various other alternatives of loading, as shown on Figure 2, are available to give a flexibility that insures maximum usefulness of every experimental facility. The normal loading for most of the development work anticipated will be of a "slab" (rectangular) configuration on the east side, or a square arrangement on the south end as shown in Figure 2. Slab loading west, square loading center, and square loading north may never be required. The core and reflector are cooled by demineralized water. The flow rate through the fuel assemblies is 30 ft/sec. The cooling water also functions as the moderator. Fourteen of the beryllium pieces adjacent to the fuel elements in the "active section," as shown in Figures 1 and 2 (slab loading), are removable in 3x3x36"

SUMMARY OF EXPERIMENTAL FACILITIES

TYPE OF HOLE	FACILITY DESIGNATION	SIZE, IN.	APPROACH	ESTIMATED FLUX (MAX.)		REMARKS
				THERMAL	FAST*	
Through	VT2	2 3/4 x 2 3/4	Vertical thru shim rod hole	2.5×10^{14}	1×10^{14}	An attempt is being made to provide a return loop for slurry experiments.
Through	HT1	4 7/8 x 4 7/8	Horizontal thru reactor	1.8×10^{14}	3×10^{13}	Next to core, loop thru HG2 for slurry.
Beam	HB1, 2, 3	6 ID in Be	Horizontal to core edge	5×10^{14}	7×10^{13}	{ One can be 1/4 mile beam, and one for neutron spectrometer not to be installed initially.
Beam	HB4, 5, 6	6 ID in Be	Horizontal to Be in active sect.	2.8×10^{14}	2×10^{11}	
Beam	HG9	10 x 16	Horizontal to tank wall	8×10^{13}	4×10^{12}	5 x 12 fast neutron channel to core.
Beam	DB1, 2, 3, 4, 5, 6	6 ID	Inclined down to tank	4×10^{13}	5×10^{10} (DB2 only)	2 ID can channels to core.
Thermal	T2	6 ft. x 6 ft.	Horizontal to Pb window	1×10^{12} Max.		Thermal column.
Thermal	T2H1, 2	4 x 4	Horizontal across T2	2×10^{10}		East-west thru structure.
Thermal	T2H3, 4, 5, 6, 7, 8	4 x 4	Horizontal parallel to T2	6×10^{12}		Within T2, to the Pb window.
Thermal	T2V1, 2	12 x 12	Vertical from top of pile	2×10^{11}		Extend to bottom of T2.
Pneumatic Rabbit	HR1, 2	1 ID	Horizontal thru reactor	1.6×10^{14}	4×10^{13}	Next to core, air operated.
Pneumatic Rabbit	HR3, 4	4 ID	Horizontal to reactor tank	8×10^{13}		Pneumatically operated.
Hydraulic Rabbit	WH1, 2	1 ID	Vertical from basement	2.4×10^{14}		In Be, hydraulically operated.
Hydraulic Rabbit	WH3, 4	1 1/2 ID	Vertical from top	2.5×10^{14}	10^{13}	In Be, spare regulating rod holes.
Instrument	WN1, 2, 3, 4, 5, 6	2 1/2 ID	Slant from top	5×10^{13}		In graphite pebble zone.
Through	HT2, 3	10 3/4 ID	Horizontal thru reactor	10^{13}		North-south thru graphite.
Through	HG1, 2	8 ID	Horizontal thru reactor	10^{13}		East-west in graphite.
Through	HG3, 4	4 ID	Horizontal thru reactor	10^{13}		East-west in graphite.
Beam	HG5, 6	6 ID	Horizontal to tank wall	8×10^{13}		Elevation mid-height of core.
Isotope	VG1, 3, 5, 6	4 ID	Vertical from top	3×10^{13}		In graphite pebble zone.
Isotope	VG2, 4	4 ID	Vertical thru reactor	3×10^{13}		In graphite, discharge to canal.
Access	VG9	10 x 10	Vertical from top	3×10^{13}		Access to HG9.
Isotope	VG7, 8, 10-20	2 1/2 ID	Slant from top	7×10^{13}		Terminate in graphite pebble zone.
Isotope	VG23-40, 42-45 47-63	2 ID	Vertical from top	$10^{13} - 10^{12}$		In graphite zone.
Gamma	GT1, 2	6 ID	Vertical from top	500r/hour		Gamma thimble in water.
Fast Flux	~40 Be Ass'ys.	3 x 3	Vertical from top tank**	5×10^{14} Max.	7×10^{13} Max.	Removable reflector pieces.
Fast Flux	~15 Be Ass'ys.	3 x 3	Vertical from top tank**	5×10^{14} Max.	7×10^{13} Max.	Removable Be in core.
Shielding	Facility		Horizontal from North	10^{12}		Special handling equipment and converter plate to be installed when needed.

* Neutrons having energies > 1 mev.

** Charged or discharged only when reactor is shut down and top plug is removed.

Note: These estimated neutron flux values are based on beryllium or graphite (according to material penetrated) in the experimental holes. Actual experimental apparatus and samples will cause local "sinks" and reduce the flux attainable for a particular experiment.

FIG. 1
PICTORIAL CROSS SECTION
REACTOR TANK

FIGURE 2

pieces. These pieces actually have a total length including lower diameter end boxes of 49 7/16". These positions may have substitute assemblies installed for special tests. Also 43 beryllium assemblies can be removed from the reflector and their places can be used as irradiation facilities. There are eight positions for shim-safety rods of the roughly 3x3 in. module by 13 ft 7 1/8 in. long that come down through the core shown in Figure 1. One of these will be removed and the position used as a through hole. This facility will make available approximately 1×10^{14} nv with $E > 1$ mev and 2.5×10^{14} nv thermal. The tank wall and the reflector have six thimbles that penetrate to the edge of the active core, the open end of the thimbles being at the tank wall. These line up with experimental holes through the shield and allow either beam experiments or samples to be placed in the maximum thermal flux. The slow flux in the beryllium reaches a maximum of $\sim 5 \times 10^{14}$. Besides these, there are other beam holes, pneumatic and hydraulic "rabbits", a large thermal column, instrument holes, through holes, an experimental shielding facility, etc., that are itemized in detail in the section Detailed Disclosure. The tank is surrounded by replaceable graphite spheres contained in a square array of permanent graphite blocks. A double wall mild steel thermal shield, with a cooling air annulus between the plates, surrounds the graphite. This in turn is surrounded by a concrete biological shield.

The experimental holes have cooled plug assemblies which are removable. These are to be replaced by special plugs designed and fabricated by the experimentalists for specific test purposes. The plugs are discussed in the Detailed Disclosure and Use of the Reactor sections.

B. Laboratory and Shop Facilities.

In addition to the auxiliaries necessary to the operation of the

reactor, a limited number of laboratory facilities will be provided at the Materials Testing Reactor site. Present plans are to hold these facilities initially to a minimum within the bounds of adequacy. When exact needs materialize, these facilities will be expanded. The reactor building wing design (see first floor plan 3150-897-402) includes: A counting room, 13 laboratories, machine and instrument shops. Adequate stores of experimental equipment and possible materials for fabrication of equipment are planned.

The counting room will be furnished with accurately regulated voltage. Closely controlled air conditioning will be a feature of this room. Various types of laboratory benches and hoods will be supplied as needed. The benches will be equipped with standard services such as hot and cold filtered water, demineralized water, regular drain sinks, hoods, gas, air; 115, 220, and 440 volt outlets; and a "warm" waste disposal system. The floors of the nine laboratories that form an "L" headed by the "Health Physics" room as shown on BK 3150-897-402 will be strong enough to allow the construction of "hot caves." Two 2 in. vent pipes with high velocity suction blowers will be installed in the hoods (in addition to regular blowers) for work with active materials. These vents exhaust to the filter house and on up the active gas stack. Offices, drafting room, and library will be provided. The instrument shop is to be used for building, calibrating, and maintaining instruments for reactor operation. Also, this facility will be available for minor rework and calibration of instruments used on specific experiments under the supervision of the scientist in charge of the particular instrument. This shop will not undertake a complete instrument service to experimenters, the philosophy being that instruments and special experimental equipment will be fabricated at the national laboratory or other institution for which the experiment is conducted. This same policy applies to the machine shop. Its principal use will be in connection with the

NO.	DESCRIPTION	BY	DATE	CHEMICAL PLANTS DIVISION	
				BLAW-KNOX CONSTRUCTION COMPANY	PITTSBURGH, PA.
1				UNITED STATES ATOMIC ENERGY COMMISSION	
2				ORNL OPERATIONS	
3				MATERIALS TESTING REACTOR	
4				REACTOR WING	
5				PLAN, ELEVATION, & SECTIONS	
6				CONCRETE	
7				DKC-3150	
8				3150-697-401	

operation of the reactor and auxiliaries plus "on the spot" reworks and alterations of special equipment for experimenters. The machine shop at the MTR site will be equipped with versatile machine tools that will make it adequate for general metal working jobs. Very large machining, beryllium machining, and radioactive materials machining will have to be done elsewhere. Central shops serving the entire testing station area will also be available. Extensive stores of materials and equipment will be obtainable at a central warehouse serving all of the reactor projects in the testing station area. No hot shops or laboratories will be built initially.

III. USE OF REACTOR

The operating staff of the Materials Testing Reactor will include engineers, physicists, chemists, and draftsmen who will help experimenters plan their experimental equipment as it is affected by reactor characteristics, configuration, and supplied facilities. In most cases this service will take the form of a recommended experimental plug design based on: 1 - making accessible the space and flux desired by the experimenters; 2 - providing adequate cooling; 3 - providing adequate handling methods, coffins, etc.; 4 - providing good shielding. Other considerations will be the effect on other experiments, cost, and maximum utilization of reactor time. In other cases the plug or plugs will be only a part of a somewhat complex system such as a slurry experiment.

The MTR staff will not design or fabricate experimental apparatus or instruments other than those required for reactor operation. To do this would require greater numbers of engineers, draftsmen, instrument mechanics, and machinists than are being provided for in the planning of shops, etc. The reactor operating staff will supply the necessary data, drawings, and recommen-

dations to enable the experimenters to design and fabricate applicable equipment in their own drafting rooms and shops. Further, the MTR drafting group, instrument shop, and machining facilities will be available for necessary "on the spot" reworks and minor additions to experimental apparatus and accompanying equipment. Operating personnel will assist in making the installation and calibration of equipment.

It is recommended that scientists wishing to use the facilities of the Materials Testing Reactor communicate such desires to the reactor personnel as soon as they have clearly in mind the object of the experiment under consideration. The specific problem will be assigned to a liaison engineer or physicist. This man will cooperate in the planning, installation, test, and dismantling. This liaison man will furnish reactor data, drawings, etc., and arrange for consultations with any of the reactor project staff who may be of help to the experimenters. He will prepare the recommendations of the operating staff based on experience accumulated as various problems are met and solved on other experiments. Each experiment will be approved by the operating personnel in respect to safety. The paramount purpose of the liaison group will be to see to it that the needs of experimenters are expeditiously supplied. If the scientists avail themselves of this liaison service early in the planning stage of experiments, it is believed that their tests can be arranged and conducted so that the total elapsed time will be comparable to that encountered in using lower flux facilities of current reactors.

One important additional function of the liaison group will be to schedule the experimental work so that the minimum amount of interference will occur. Due to the fact that there are the maximum number of experimental holes in the

reactor, each experimental hole has some effect on its neighbors. The liaison group will calculate these effects and take them into account in scheduling the experimental work.

The reactor area is served by the Union Pacific Railroad and by Empire and Western Airlines. The freight address for carload and less than carload freight will be Scoville, Idaho. Passengers can be met at Pocatello or Idaho Falls.

IV. DETAILED DISCLOSURE OF EXPERIMENTAL FACILITIES IN THE REACTOR.

As previously mentioned, a great many experimental access holes are incorporated into the MTR design. Tables I through VIII (compiled from ORNL design section list, DRP 64 A) enumerate them giving identifying designations, size, location, and penetration into the pile; i.e., nearest point of access to the neutron source. Also, reference is made to the drawings that illustrate the location of the facilities relative to each other and important parts of the reactor structure. The tables do not list the special shielding facility and the replacable beryllium facilities. These are discussed in later paragraphs in this section.

An attempt has been made to give reasonable estimates of the neutron field intensities that will be available at the various positions when the reactor is operated at 30,000 kw, its design point. The curve sheets, Figures 3 & 4* show the estimated distribution based, to some extent, on critical experiments carried out at Oak Ridge National Laboratory and reported in ORNL-167. This critical assembly only approximated the active section of the Materials Testing Reactor. The dimensions of the core and the beryllium reflector were different and there was no water reflector at the top and

*These curves were taken from an ORNL memorandum, Central Files No.49-10-232.

TABLE I HORIZONTAL BEAM HOLES

<u>Design- nation</u>	<u>Size</u>	<u>Penetration</u>	<u>Location</u>	<u>Reference Drawing</u>	<u>Estimated Flux</u>
HB1	6 in. ID	To active section edge on reactor horizontal center line.	Horizontal approach on line 27° north of east, intersecting edge of active section 10 $\frac{1}{4}$ in. north of reactor center line at elevation 100 ft.	DRP-62 DRP-68	4x10 ¹⁴ Th. 7x10 ¹³ Fast
HB2	6 in. ID (8 in. to Tank)	8 in. ID from shield face to tank wall, 6 in. ID to active section edge on reactor horizontal center line.	Horizontal approach from east, on E-W center line of reactor at elevation 100 ft.	DRP-62 DRP-68	5x10 ¹⁴ Th. 7x10 ¹³ Fast
HB3	6 in. ID	To active section edge on reactor horizontal center line.	Horizontal approach on line 27° south of east, intersecting edge of active section 10 $\frac{1}{2}$ in. south of reactor center line at elevation 100 ft.	DRP-62 DRP-68	4x10 ¹⁴ Th. 7x10 ¹³ Fast
HB4	6 in. ID	To active section edge on reactor horizontal center line.*	Horizontal approach on line 27° north of west, intersecting edge of active section 10 $\frac{1}{4}$ in. north of reactor center line at elevation 100 ft.	DRP-62 DRP-68	2.8x10 ¹⁴ Th. 2x10 ¹¹ Fast
HB5	6 in. ID (8 in. to Tank)	8 in. ID from shield face to tank wall 6 in. ID to active section edge on reactor horizontal center line.*	Horizontal approach from west on E-W center line of reactor at elevation 100 ft.	DRP-62 DRP-68	2.8x10 ¹⁴ Th. 2x10 ¹¹ Fast
HB6	6 in. ID	To active section edge on reactor horizontal center line.*	Horizontal approach on line 27° south of west, intersecting edge of active section 10 $\frac{1}{4}$ in. south of reactor center line at elevation 100 ft.	DRP-62 DRP-68	2.8x10 ¹⁴ Th. 2x10 ¹¹ Fast

* When the reactor is slab loaded with the fuel elements concentrated on the east side, the HB4, HB5, and HB6 facilities have 15.6 cm. of Be with 2% water between the end of the hole and the fuel assemblies. See Figure 2 for loading arrangements.

TABLE II DOWN BEAM HOLES

<u>Designation</u>	<u>Size & Approach</u>	<u>Penetration</u>	<u>Location</u>	<u>Reference Drawing</u>	<u>Estimated Thermal Flux</u>
DB1	6 in. ID From N-E		Located above center of reactor and in same vertical plane as corresponding HB facility. Inclines downward moving toward reactor and has a center line in a plane making an angle of 30° with horizontal. The 6 in. hole extends inward to the tank wall; a sealed 2 in. ID can inside the tank goes from this point to intersection with the active section at elevation 100 ft 9.75 in. Approximately 1.5 in. of aluminum and 20 in. of air lie between active section and innermost point of accessibility.	DRP-62 DRP-68	4x10 ¹³
DB2	6 in. ID From east			DRP-67 DRP-68	4x10 ¹³ 5x10 ¹⁰ Fast
DB3	6 in. ID From S-E	To reactor tank wall, with a 2 in. ID can inside between tank wall and active section.		DRP-62 DRP-68	4x10 ¹³
DB4	6 in. ID From N-W			DRP-62 DRP-68	4x10 ¹³
DB5	6 in. ID From west			DRP-67 DRP-68	4x10 ¹³
DB6	6 in. ID From S-W			DRP-62 DRP-68	4x10 ¹³

VERTICAL THROUGH HOLE

VT2	2 3/4 in. sq.	Active Section	One shim rod position, 3.09 in. south of the E-W center line on the N-S center line of the slab when loaded on the east side of the active section space, can be used for an irradiation facility operated from the top of the reactor.	Fig. 1 Fig. 2	2.5x10 ¹⁴ 1x10 ¹⁴ Fast
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VERTICAL SHIELD HOLES

VC1 thru 2 in					
VC15	2 in. ID	Concrete	Vertical holes from top of structure to elevation 92 ft.	DRP-61	

TABLE III VERTICAL HYDRAULIC RABBITS

<u>Designation</u>	<u>Size</u>	<u>Penetration</u>	<u>Location</u>	<u>Reference Drawing</u>	<u>Estimated Thermal Flux</u>
VH1	1 in. ID	Be Reflector	Vertical facility running the height of the reflector at point 16.7 in. south, 6.07 in. west of reactor center line. Specimens charged in basement for delivery by water to exposure point. Specimen cooled by water discharging past capsule container into reactor tank just above reflector. Specimens returned by reactor water pressure.	DRP-62	2.4×10^{14}
VH2	1 in. ID	Be Reflector	Same as VH1, located 16.7 in. south, 6.07 in. east of reactor center line.	DRP-62	2.2×10^{14}
VH3 & VH4	1.5 in. ID	Be Reflector	Vertical hydraulics similar to VH1 and VH2, occupying spare regulating rod spaces in reflector. Located 5.25 in. north or south, and 9.56 in. east or west of reactor center lines depending on which way the pile is loaded.	DRP-62	2.5×10^{14} 10^{13} Fast*

VERTICAL INSTRUMENT HOLES

VN1, VN2 VN3, VN4, $2\frac{1}{2}$ in. ID VN5, VN6	Graphite Pebble Zone	Straight slanting holes, the center lines of which form a truncated cone having an 8 ft diameter at the top of the reactor structure and 5 ft 4 in. diameter at elevation 100 ft 5 in. where the holes terminate. The center line of the cone is coincident with the reactor center line.	DRP-67 & DRP-61	5×10^{13}
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* Two rows of beryllium assemblies (in the "active section") are between spare regulating rod positions and the fuel assemblies when the reactor is slab loaded.

TABLE IV HORIZONTAL PNEUMATIC RABBITS

<u>DESIG- NATION</u>	<u>SIZE</u>	<u>PENETRATION</u>	<u>LOCATION</u>	<u>REFERENCE DRAWING</u>	<u>ESTIMATED THERMAL FLUX</u>
HR1	1 in. ID	Reflector, parallel and next to the active section	East-west horizontal pneumatic tube through reactor structure and tank 1 ft 3 7/16 in. south of reactor center line. Enters structure at elevation 99 ft 5 5/16 in. and makes a 4 ft radius "S" bend to pass through tank and graphite at elevation 99 ft 2 5/16 in.	DRP-62 DRP-66	1.6×10^{14} 4×10^{13} Fast
HR2	1 in. ID	Reflector, parallel and next to the active section.	East-west horizontal pneumatic tube through reactor structure and tank 1 ft 3 7/16 in. south of reactor center line. Enters structure at elevation 98 ft 9 5/16 in. and makes a 4 ft radius "S" bend to pass through tank at elevation 99 ft 5/16 in.	DRP-62 DRP-66	1.7×10^{14} 4×10^{13}
HR3	4 in. ID	To reactor tank	Horizontal holes for oriented samples. Approaching reactor radially from north face of structure on line 30° west of north at elevation 100 ft extending inward to reactor tank.	DRP-62 DRP-68	8×10^{13}
HR4	4 in. ID	To reactor tank	Horizontal holes for oriented samples. Approaching reactor radially from north face of structure on line 30° east of north at elevation 100 ft extending inward to reactor tank.	DRP-62	8×10^{13}

HORIZONTAL THROUGH HOLE

HT1	4 7/8 in. Sq. inside	Reflector	Through hole from side to side of reactor structure, through reactor tank adjacent to north end of active section 1 ft 5 7/16 in. from reactor center line at elevation 99 ft 3 3/4 in. (Dimensions to center line of the hole).	DRP-62 DRP-66	1.8×10^{14} 3×10^{13} Fast
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TABLE V HORIZONTAL INSTRUMENT HOLE

<u>DESIG- NATION</u>	<u>SIZE</u>	<u>PENETRATION</u>	<u>LOCATION</u>	<u>REFERENCE DRAWING</u>	<u>ESTIMATED THERMAL FLUX</u>
HI2	10.75 in. ID	Graphite	Horizontal through reactor structure, running north-south, 4 ft 6 in. east of pile center line at elevation 104 ft 3 in.	DRP-67 DRP-62 DRP-68	1.4×10^{13} -
HI3	10.75 in. ID	Graphite	Horizontal through reactor structure, running north-south, 4 ft 6 in. west of pile center line at elevation 104 ft 3 in.	DRP-67 DRP-62 DRP-68	1.4×10^{13}

THERMAL COLUMN VERTICAL HOLES

T2V1	12 in. Sq.	T2, perpendicular to the axis of T2	Vertical stringer, extending downward through thermal column from top of structure, located 10 ft 3 in. south of reactor center line, and 1 ft 7/8 in. east of reactor center line.	DRP-62 DRP-66	2×10^{11}
T2V2	12 in. Sq.	T2, perpendicular to the axis of T2	Vertical stringer, extending downward through thermal column from top of structure, located 10 ft 3 in. south of reactor center line, and 9 7/8 in. west of reactor center line.	DRP-62 DRP-66	2×10^{11}

GAMMA THIMBLES

GT1	6 in. ID	Discharge water line	Vertical thimble from top of structure in north-west discharge water line for gamma exposures. Located 7 ft north of E-W center line and 8 ft 6 in. west of N-S center line. Extends to elevation 109 ft 3 in.	DRP-62	500r/hr. N ¹⁶ activity
GT2	6 in. ID	Discharge water line	Vertical thimble in south-east discharge water line. Located 7 ft south of E-W center line and 8 ft 6 in. east of N-S center line. Extends to elevation 109 ft. 3 in.	DRP-62	500r/hr. N ¹⁶ activity

TABLE VI THERMAL COLUMN HOLES

<u>DESIG- NATION</u>	<u>SIZE</u>	<u>PENETRATION</u>	<u>LOCATION</u>	<u>REFERENCE DRAWING</u>	<u>ESTIMATED THERMAL FLUX</u>
T2	6 ft Sq.	To thermal shield	6 ft square inner end, expanding to approximately 6 ft 4 in. at outer end, south side of reactor on N-S center line.	DRP-62 DRP-66	10^{12}
T2H1	4 in. Sq.	T2, perpendicular to the axis of T2	Horizontal stringer through reactor structure, running east-west, 13 ft south of reactor center line at elevation 101 ft 4 in.	DRP-62 DRP-66	2×10^{10}
T2H2	4 in. Sq.	T2, perpendicular to the axis to T2	Horizontal stringer through reactor structure, east-west, 13 ft south of reactor center line at elevation 98 ft 8 in.	DRP-62 DRP-66	2×10^{10}
T2H3	4 in. Sq.	To thermal shield	Through thermal column horizontally to thermal shield. 1 ft 8 in. west of reactor center line at elevation 101 ft 10 in.	DRP-62	6×10^{11}
T2H4	4 in. Sq.	To thermal shield	Through thermal column horizontally to thermal shield. 1 ft 11 in. east of reactor center line at elevation 101 ft 10 in.	DRP-62 DRP-68	6×10^{11}
T2H5	4 in. Sq.	To thermal shield	Through thermal column horizontally to thermal shield. 1 ft 8 in. west of reactor center line at elevation 100 ft.	DRP-62 DRP-68	6×10^{11}
T2H6	4 in. Sq.	To thermal shield	Through thermal column horizontally to thermal shield. 1 ft 11 in. east of reactor center line at elevation 100 ft.	DRP-62 DRP-68	6×10^{11}
T2H7	4 in. Sq.	To thermal shield	Through thermal column horizontally to thermal shield. 1 ft 8 in. west of reactor center line at elevation 98 ft 2 in.	DRP-62 DRP-68	6×10^{11}
T2H8	4 in. Sq.	To thermal shield	Through thermal column horizontally to thermal shield. 1 ft 11 in. east of reactor center line at elevation 98 ft 2 in.	DRP-62 DRP-68	6×10^{11}

TABLE VII VERTICAL GRAPHITE HOLES

<u>Designation</u>	<u>Size</u>	<u>Penetration</u>	<u>Location</u>	<u>Reference Drawing</u>
VG1	4 in. ID	Graphite pebble zone	Vertical straight hole from top of reactor structure through pebble zone to bottom of graphite reflector, elevation 96 ft, 3 ft $1\frac{1}{2}$ in. from north-south and east-west center lines.	DRP-62
VG3	4 in. ID	Graphite pebble zone		
VG5	4 in. ID	Graphite pebble zone		
VG6	4 in. ID	Graphite pebble zone		
VG2	4 in. ID	Graphite N-W side.	Vertical through hole from top of reactor structure into canal, 4 ft 2 in. from E-W center line, 1 ft 4 in. from N-S center line.	DRP-62
VG4	4 in. ID	Graphite S-E side.	Vertical through hole from top of reactor structure into canal, 4 ft 2 in. from E-W center line, 1 ft 6 in. from N-S center line.	DRP-62
VG7, 8, 10 - 20.	$2\frac{1}{2}$ in. ID	Graphite pebble zone.	Straight slanting holes, the center lines of which form a truncated cone with a vertical axis coincident with the reactor tank center line. The holes commence at the top of the structure, the frustum at this point being 8 ft in diameter, and terminate at elevation 98 ft 4 in. where the frustum is 5 ft 8 in. in diameter; angular orientation of holes shown on DRP-61.	DRP-62 DRP-67 DRP-61
VG9	10 in. Sq.	Graphite to HG9 hole.	Vertical access to HG9 hole located 4 ft. 5 in. south of E-W center line and $1\frac{1}{2}$ in. east of north-south center line.	DRP-62 DRP-66
VG23 thru 40, VG42 thru 45, VG47 thru 63.	2 in. ID	Graphite	Vertical stringers from top of structure thru graphite. Located as shown on DRP-61.	DRP-62 DRP-61

Note: The thermal flux in these holes varies from 5×10^{13} to 10^{12} according to location.

TABLE VIII HORIZONTAL GRAPHITE HOLES

<u>Designation</u>	<u>Size</u>	<u>Penetration</u>	<u>Location</u>	<u>Reference Drawing</u>	<u>Estimated Thermal Flux</u>
HG1	8 in. ID	Graphite	Through reactor structure, running east-west, 5 ft 3 in. north of reactor center line at elevation 101 ft 6 in.	DRP-62 DRP-66	10^{13}
HG2	8 in. ID.	Graphite	Through reactor structure, running east-west, 5 ft 3 in. north of reactor center line at elevation 98 ft 6 in.	DRP-62 DRP-66	10^{13}
HG3	4 in. ID	Graphite	Through reactor structure, running east-west, 5 ft $1\frac{1}{2}$ in. south of reactor center line at elevation 101 ft 2 in.	DRP-62 DRP-66	10^{13}
HG4	4 in. ID	Graphite	Through reactor structure, running east-west 5 ft $1\frac{1}{2}$ in. south of reactor center line at elevation 98 ft 10 in.	DRP-62 DRP-66	10^{13}
HG5	6 in. ID	To reactor tank	Horizontal, approaching reactor radially from south face of reactor on line 30° east of south at elevation 100 ft extending inward to reactor tank.	DRP-62 DRP-68	8×10^{13}
HG6	6 in. ID	To reactor tank	Horizontal, approaching reactor radially from south face of structure on line 30° west of south at elevation 100 ft extending inward to reactor tank.	DRP-62 DRP-68	8×10^{13}
HG9	10 in. x 16 in.	To reactor tank wall with 5.25 x 12 in. neutron channel inside between tank wall and active section. 12 in. dimension is vertical.	Horizontal hole to reactor tank, $1\frac{1}{2}$ in. east of reactor center line, and at elevation 99 ft 9 $11/16$ in. The center line of the facility is parallel to the N-S center line of the reactor. There are approximately 3 in. aluminum and 10 in. of air between active section and innermost point of accessibility.	DRP-62 DRP-66	8×10^{13} 4×10^{12} Fast

REFERENCE DRAWINGS.

REFERENCE DRAWINGS

- DAD-61 Desator Structure-Top Plan-Fund. Dim.
- DAD-63 Desator Structure-Plan Sect. Detail & Fund. D.m.
- DAD-64 Experimental Plan for the Understructure
- DAD-65 Graphing of Desator Tank & H. Sect. Elev. Fund. D.m.
- DAD-66 Desator Structure-H. Sect. Elev. Fund. Dim.
- DAD-67 Desator Structure-H. Sect. Elev. Fund. Dim.
- DAD-68 Desator Structure-Elev. Views Fund. D.m.
- DAD-67 Structural Steel Proposal
- DAD-67 Desator Structure-Exp. Psc. Plug
Liner Orientation.

DO NOT SCALE THIS CHARTYARD

APPD	DATE	OAK RIDGE NATIONAL LABORATORY	
		TECHNICAL DIV — RD 242 R — OAK RIDGE, TENN.	
		MTD	105 BLDG
		PLANT VIEW REACTOR STRUCTURE	
		EXPERIMENTAL & SERVICE	
		FACILITIES	
		DESIGN BY	DATE
		CRD	2-24-69
		ENGINEER BY	DATE
			1100-42

NOTES

1. REFERENCE DRAWINGS
 DDP 61, Factor Structure Top Plan Fundamental Dim
 DDP 62, Factor Structure Plan Flow Experimental
 & Service Facilities
 DDP 64, Experimental Facilities Wt. Hm. Enclosure
 DDP 72, Factor Structure Balcony Details
 Balcony not shown on East Elevation
 2. Shaded area indicate steel plate embedded in
 face of structure. Note unless otherwise shown
 East and West Elevations are similar except
 as shown
 3. North and South Elevations are similar except
 as shown

SOUTH ELEVATION

THIS DRAWING SUPERSEDES DDP 24

NOT 5 340

DATE	BY	CHKD	APPD	DATE
10/1/68	W. J. R.	W. J. R.	W. J. R.	10/1/68
SAK RIDGE NATIONAL LABORATORY				
TECHNICAL DIVISION - 40 BOX F - SAK RIDGE, TENN.				
MTR 105 BLDG				
REINFORCED CONCRETE				
EAST ELEVATION				
FUNDAMENTAL DIMENSIONS				
DRAWN BY: DATE: SCALE: 1/8" = 1'-0"				
CHECKED BY: DATE: 10/1/68				
PROJECT NO. DDP 68

Redrawn from ORNL Dr. 7949

Fig. 4

bottom. Critical experiments are now in progress at Oak Ridge using the MTR "Mock-up."

The neutron flux at the various points of closest accessibility can be controlled to some degree by the type (slab or square) and location of the fuel assembly arrangement. The various loading possibilities are illustrated in Figure 2. However, the slab loading west side, square loading center, and square loading north probably will not be used because of undesirable affect on the HG 9 facility. The active core section is made up of five parallel rows of nine assembly positions. Thirty-seven of these positions are designed to locate either active fuel plate assemblies or beryllium assemblies of the same external configuration as the fuel assemblies. The other eight positions are shim-safety rod spaces. For slab loading all assembly positions in three rows along one side have fuel assemblies installed, thus making 23 fuel assemblies in place and four shim-safety rods among them. The remaining two rows of positions are filled with beryllium assemblies except for the four safety rods installed in the positions provided for them. One shim-safety rod located on the north-south center line of the slab loading can be removed and the position used as a vertical through hole. Samples will be loaded at the top. An attempt is being made to design a return loop outside the tank. Fast nv available ($E > 1 \text{ mev}$) approximates 10^{14} .

Plugs and experimental apparatus installed in the various experimental holes will require considerable cooling. It is estimated that 170 watts per sq. cm. will be generated in the HB2 hole based on the surface facing the active section i.e., the area of a six inch circle. Demineralized cooling

water (approximately 8 gpm in the case of the HB2 hole) will be provided for cooling those facilities that penetrate past the reactor tank wall into the beryllium reflector. The facilities that terminate in or pass through the graphite will be air cooled. This air will be exhausted into the main graphite cooling air system and hence through the filter house and up the active gas stack.

Since the radiation intensity in the beam holes is quite high, careful precautions are being taken to contain the neutrons and gamma rays in the pile and reduce radiation leaks to a very low level. The building and other structural masses are being so arranged that a "quarter mile beam" facility can be set up at some future date using one of the horizontal beam holes. Also, plans call for a neutron spectrometer installation at another of the beam holes. The design of the reactor includes plugs for all of the facilities. MTR 3018E shows a layout of a horizontal beam hole liner into which a plug fits. These plugs are just neutron and gamma ray stoppers and will be replaced by plugs that accommodate specific experiments. Experimenters wishing to test flowing coolants, component parts, etc. will receive the help of engineers and physicists of the Materials Testing Reactor operating staff in designing experimental plugs to contain their apparatus and samples, and correctly position them while still offering adequate shielding for personnel and instruments.

Special provisions are incorporated in the reactor design for testing slabs of shielding materials. Drawings DRP 73, 74, and 75 illustrate the design of this facility. Essentially it consists of a long tank one end of which is an integral part of the reactor structure and extends inward to the

lead window in the thermal shield. The tank floor has tracks and a driving mechanism to move a low flat car or dolly in and out of the reactor. Slab samples of shielding material can be mounted on the dolly and moved in or out of the reactor while the reactor is operating. This is made possible by filling the tank with water to a depth that completely fills the opening in the reactor face and to a depth sufficient to give adequate shielding. When a slab sample is moved outward, water immediately takes its place. The slabs will be loaded and unloaded by the 30 ton overhead traveling crane. The tank dimensions are adequate to completely encompass the top of a deep-well storage pit into which the more radioactive portions of test slabs can be placed. An auxiliary traveling crane on the tank structure may be provided to facilitate this procedure. The same rails along which this crane moves might also be used as guides for instrumentation.

A converter plate is designed to be movable into position at the innermost end of the shielding facility tank to provide a source of fast neutrons. This plate will be made of enriched uranium-aluminum alloy clad with aluminum and the assembly will be cooled with demineralized water. The thermal neutron flux available at the innermost surface is $\sim 10^{12}$. The plate is designed with a boron iris plate attachment in order to sharply define the geometry of the source. The plate and holder assembly is mounted on the end of the dolly and is removed into a coffin when it is not being used.

The active section, see Figure 1, of the reactor is designed with more fuel assembly spaces than are needed for criticality and excess reactivity for normal operation. These spaces will be filled with 3x3x49 in. beryllium assemblies that have external configuration similar to fuel assemblies. However, these beryllium pieces are removable and can be replaced with

experimental or breeder assemblies. The maximum thermal flux available in these positions is $\approx 5 \times 10^{14}$ and the maximum fast neutron flux ($E > 1 \text{ mev}$) is $\approx 7 \times 10^{13}$. There are 14 such positions when the reactor is normally slab loaded and 16 when it is square loaded.

The beryllium reflector is designed with 43 removable beryllium assemblies, $3 \times 3 \times 38 \text{ in.}$, which can be replaced with experimental or breeder assemblies. The maximum neutron field intensity obtainable in these positions is 5×10^{14} thermal and 7×10^{13} fast ($E > 1 \text{ mev}$). Of course, the absorption and scattering characteristics of the assemblies substituted for the beryllium limits the number of these positions that can be used at any one time, and also tends to give a local depression of the flux curve; thus values less than those quoted are effectively available.

References:

1. Research Pile Experimental Facilities
by J. T. Weills, April 8, 1947
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by R. M. Jones, ORNL CF-49-4-122
4. MTR Experimental Facilities
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5. Critical Experiments for the High Flux Reactor
by A. B. Martin and M. M. Mann, ORNL 167.
6. MTR Design Data Sheets
by D. Mallon, ORNL CF-49-10-232